UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF PREVENTION,
PESTICIDES AND
TOXIC SUBSTANCES

August 10, 2000

MEMORANDUM

SUBJECT: DICLOFOP-METHYL. The **Revised** HED Chapter of the Reregistration Eligibility Decision Document (RED). PC Code: 110902. Case # 2160. DP Barcode: D267139.

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Attached please find the **revised** Health Effects Division's (HED's) risk assessment for diclofop-methyl, for the purpose of issuing a reregistration eligibility decision (RED) document. This revised assessment takes into account comments made by the registrant (Aventis) during the 30-day error correction period (Phase 1) of the public participation process. Revisions to this assessment include a new endpoint for short- and intermediate-term inhalation assessment and the incorporation of transfer coefficients established by the Agricultural Reentry Task Force, as well as revisions to the dietary exposure section. Cumulative risk assessment considering risks from other pesticides or chemical compounds having a common mechanism of toxicity is not included in this assessment. The disciplinary science chapters and other supporting documents are included as attachments as follows:

Drinking Water Memorandum for Diclofop-Methyl. Subijoy Dutta; 10/14/99. D260166.

Product Chemistry Chapter for the Reregistration Eligibility Decision (RED) Document. Ken Dockter; 12/22/99. D259909.

Third Report of the Hazard Identification Assessment Review Committee. Robert F. Fricke; 08/01/00.

Review of Diclofop-Methyl Incident Reports. Jerome Blondell and Monica F. Spann; 04/07/00. D264817.

Outcome of the HED Metabolism Assessment Review Committee Meeting on 4/4/00. Sheila Piper; 04/07/00. D264794.

Report of the FQPA Safety Factor Committee. Brenda Tarplee; 04/24/00.

Residue Chemistry Chapter for the Reregistration Eligibility Decision (RED) Document. Sheila Piper; 05/02/00. D265277.

Toxicology Chapter for the RED. Robert F. Fricke; 05/04/00. D252787.

Report of the Cancer Assessment Review Committee. Sanjivani Diwan; 05/24/00.

Revised Dietary Risk Assessment. Richard Griffin; 08/03/00. D267649.

Revised Occupational and Residential Exposure Assessment and Recommendations. Seyed Tadayon; 08/02/00. D267650.

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1.0 EXECUTIVE SUMMARY

The Agency has conducted a human health risk assessment for the active ingredient diclofop-methyl [methyl 2-(4-(2,4-dichlorophenoxy)phenoxy)propanoate] for the purpose of making a reregistration eligibility decision. Diclofop-methyl is a herbicide that controls wild oats and annual grassy weeds in wheat and barley, as well as in established bermuda grass turf on golf courses. There are no registered residential uses of diclofop-methyl; however, there is potential post-application exposure to golfers. Diclofop-methyl is registered by Aventis Crop Science (formerly AgrEvo) under the trade name of Hoelon® and Illoxan®, and is formulated as a manufacturing product (93.0 percent active ingredient, or a.i.), and as an emulsifiable concentrate (34.7 percent a.i).

Diclofop-methyl is classified by the Agency as a restricted use pesticide due to carcinogenicity in laboratory mice, and may be purchased and used only by certified applicators. Products must carry the signal word "Danger" on their labels. Diclofop-methyl may be applied pre-plant, pre-emergent, or post-emergent, and is applied by fixed-wing aircraft and tractor-drawn equipment, as well as by hand held equipment. The maximum label rate is 1.0 lb. ai/acre for wheat and barley, and 1.5 lb. ai/acre for golf course turf. There is a maximum of one application per growing season.

The Carcinogenicity Peer Review Committee (CARC) has classified diclofop-methyl as a Group C carcinogen (possible human carcinogen) based on liver adenomas and carcinomas with significant trend and pair-wise comparisons, as seen in a mouse carcinogenicity study. For the assessment of cancer risk, a linear low-dose approach (Q_1*) should be used for human risk characterization and extrapolation. A Q_1* of 2.3×10^{-1} $(mg/kg/day)^{-1}$ is used for the human health risk assessment.

Toxic endpoints selected for risk assessment purposes are based on decreased fetal body weights, increased relative liver and kidney weights, and increased liver enzymes, proteins, and absolute and relative liver weights. Dermal absorption is calculated to be 15% from a submitted dermal absorption study, and inhalation absorption is assumed to be 100%.

An uncertainty factor (UF) of 100X was applied to the risk assessment to account for interspecies extrapolation and intraspecies variability. The FQPA safety factor for the protection of infants and children (as required by the Food Quality Protection Act of August 6, 1996) was reduced to 1X for the acute and chronic dietary risk assessments, as well as for the post-application exposure risk assessment for recreational exposure to golfers.

The target Margin of Exposure (MOE) is 100 for all occupational and post-application exposure scenarios. A MOE of $\geq$100 is considered to be not of concern for occupational exposure scenarios.

Tolerances are established for the combined residues of diclofop-methyl and its metabolites, 2-[4-

(2,4-dichlorophenoxy)phenoxy]propanoic acid and 2-[4-(2,4-dichloro-5-hydroxyphenoxy)phenoxy]propanoic acid, in or on raw agricultural commodities at 0.1 ppm. The Metabolism Assessment Review Committee (MARC) has determined that the residues of concern for plants are diclofop-methyl and its metabolites, 2-[4-(2,4-dichlorophenoxy)phenoxy] propanoic acid and 2-[4-(2,4-dichloro-5-hydroxyphenoxy)phenoxy]propanoic acid. For animals, the residues of concern are diclofop-methyl and its metabolite, 2-[4-(2,4-dichlorophenoxy)phenoxy]propanoic acid. Diclofop-methyl (parent) and its metabolites are to be considered toxicologically equivalent. Reassessed tolerances are listed in the attached Residue Chemistry chapter (S. Piper memo, 05/02/00).

The acute and chronic dietary risk assessments for diclofop-methyl are refined analyses that incorporate percent crop treated information and anticipated residues. The chronic dietary analysis indicates no risk of concern for any population subgroup, with a chronic dietary risk estimate of less than 1% of the chronic population adjusted dose (cPAD)[1] for the highest exposed population subgroup (children 1-6 years old). The acute dietary risk estimate for females 13-50 is less than 8% of the acute population adjusted dose (aPAD) at the 99.9th percentile. No appropriate acute endpoint was identified for the U.S. general population, including infants and children. Calculated risks are based on an aPAD of 0.1 mg/kg/day and a cPAD of 0.0023 mg/kg/day.

The carcinogenic risk for diclofop-methyl in the food supply is estimated to be 1.2×10^{-6}, which is at the level (1×10^{-6}) generally considered negligible by the Agency. This estimate is based on the estimated average dietary exposure of the general U.S. population, multiplied by the upper-bound potency factor (Q_1^*) of 2.3×10^{-1} $(mg/kg/day)^{-1}$.

Potential exposure and risk from diclofop-methyl residues in drinking water were assessed using Tier 2 PRZM/EXAMS (surface water) and Tier 1 SCI-GROW2 (groundwater) modeling estimates, as well as limited monitoring data and a small scale prospective groundwater study. For risk assessment purposes, surface water estimated environmental concentrations (EECs) of diclofop-methyl are 1.466 ppb (acute) and 0.097 ppb (short-term, chronic, and cancer). For groundwater, a value of 0.067 ppb was used for acute, short-term, chronic, and cancer risk assessments. Residues of diclofop-methyl in drinking water as a contribution to acute, short-term, chronic, and cancer aggregate risk (when considered along with exposure from food only) are not of concern as the DWLOCs are considerably greater than the EECs. Post-application exposure to golfers is not included in the cancer aggregate risk assessment as the carcinogenic risk estimate to golfers alone exceeds the level considered negligible by the Agency.

The Agency has determined that there are potential exposures to mixers, loaders, applicators, and other handlers during usual use-patterns associated with diclofop-methyl. The Agency has identified seven major exposure scenarios for diclofop-methyl: (1) mixing/loading liquids for

[1] PAD = Population Adjusted Dose = $\frac{\text{Acute or Chronic RfD}}{\text{FQPA Safety Factor}}$

groundboom application; (2) mixing/loading liquids for aerial application; (3) mixing/loading liquids for hand gun sprayer application; (4) applying liquids with a groundboom sprayer; (5) applying liquids with a fixed-wing aircraft; (6) applying liquids with a hand gun sprayer; and (7) flagging for liquid applications.

Calculations of **non-cancer occupational risk** based on combined dermal and inhalation exposure indicate that MOEs are not of concern (MOE > 100) with maximum risk reduction measures (personal protective equipment (PPE) or engineering controls) for all of the short- and intermediate-term occupational exposure scenarios listed above. Dermal exposure, rather than inhalation exposure, appears to be the main contributor to overall occupational exposure.

Calculations of **cancer risk** for occupational dermal and inhalation exposure range from 1.4×10^{-2} to 5.1×10^{-6} at the baseline level, 8.4×10^{-5} to 6.0×10^{-7} with PPE, and 5.8×10^{-5} to 1.4×10^{-6} at the engineering control level. The Agency is generally concerned when occupational cancer risk estimates exceed 1×10^{-4}. The Agency will seek ways to mitigate cancer risks to a level of 1×10^{-6} or less.

The Agency has determined that there are potential post-application exposures to workers in the following scenarios: mowing/maintaining golf course turfgrass and scouting of wheat and barley fields. **Non-cancer** risk estimates for occupational post-application workers indicate that entry by golf course workers to mow/maintain turfgrass is acceptable on the day of application as soon as the sprays have dried. Entry by workers to wheat or barley fields for scouting is acceptable on the day of application as soon as the sprays have dried. The calculation of **cancer risk** for post-application exposure to workers mowing/maintaining golf course turf is 9.1×10^{-6} on the day of application at the maximum application rate of 1.5 lbs. ai/acre. The calculation of cancer risk for workers scouting wheat and barley is 2.3×10^{-5} on the day of application.

Potential post-application exposure may occur to golfers and children over six years old who may accompany adults to a golf course that has been treated with diclofop-methyl. **Non-cancer** risk estimates indicate that entry by golfers to a golf course is acceptable on the day of application as soon as the spray has dried. The calculation of **cancer risk** for exposure to golfers is 2.2×10^{-6} based on exposure at the day of application for the typical application rate of 1 lb. ai/acre.

This assessment for diclofop-methyl reflects the Agency's current approaches for completing residential exposure assessments based on the guidance provided in the *Draft: Series 875-Occupational and Residential Exposure Test Guidelines, Group B-Postapplication Exposure Monitoring Test Guidelines*, the *Draft: Standard Operating Procedures (SOPs) for Residential Exposure Assessment*, and the *Overview of Issues Related to the Standard Operating Procedures for Residential Exposure Assessment* presented at the September 1999 meeting of the FIFRA Scientific Advisory Panel. The Agency is, however, currently in the process of revising its guidance for completing these types of assessments. Modifications to this assessment shall be incorporated as updated guidance becomes available. This will include expanding the scope of the residential exposure assessments by developing guidance for characterizing exposures from other

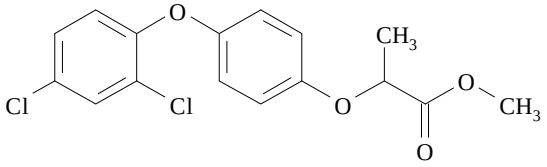
sources already not addressed such as from spray drift; residential residue track-in; exposures to farm worker children; and exposures to children in schools.

As mandated by the FQPA amendments to the Federal Food, Drug, and Cosmetic Act (FFDCA), the Agency must consider total aggregate exposure from food, drinking water, and non-occupational sources of diclofop-methyl. Acute and chronic dietary (food) exposure to diclofop-methyl is below the Agency's level of concern (<100% PAD); therefore, the Agency concludes with reasonable certainty that residues of diclofop-methyl in drinking water (when considered along with exposures from food uses) do not result in an aggregate human health risk estimate of concern.

The cancer risk estimate (2.2×10^{-6}) to golfers at the typical application rate exceeds the level generally considered negligible by the Agency (1×10^{-6}). Any aggregation of post-application exposure with food and drinking water would only increase the risk further above the Agency's level of concern. Therefore, a cancer aggregate risk assessment was conducted for food and drinking water exposure only. The Agency concludes with reasonable certainty that carcinogenic exposure to residues of diclofop-methyl in drinking water would not result in an unacceptable aggregate risk, when considered along with carcinogenic exposure to diclofop-methyl in the food supply.

2.0 PHYSICAL/CHEMICAL PROPERTIES CHARACTERIZATION

Diclofop-methyl [methyl 2-(4-(2,4-dichlorophenoxy)phenoxy)propanoate] is a herbicide used on barley, wheat, and golf courses.



Empirical Formula:	$C_{16}H_{14}Cl_2O_4$
Molecular Weight:	341.19
CAS Registry No.:	51338-27-3
PC Code:	110902

Diclofop-methyl is a colorless, crystalline solid with a melting point of 39-41 C; density of 1.30 ± 0.05 g/cm^3 at 40 C; octanol/water partition coefficient (P_{ow}) of 37,800; and vapor pressure of 1.9×10^{-6} mm Hg at 20 C. Diclofop-methyl is practically insoluble in water (0.3 mg/100 mL), and is soluble in xylene (253 g/100 mL), acetone (249 g/100 mL), and ethanol (11 g/100 mL).

Product chemistry data requirements remain unfulfilled for the Aventis (AgrEvo) 93% technical

grade active ingredient (TGAI). Additional data are required concerning product identity and composition, discussion of formation of impurities, certified limits, enforcement analytical method, pH, UV/visible absorption, and vapor pressure (OPPTS 830.1550, .1670, .1750, .1800, .7000, .7050, and .7950, respectively). Provided that the registrant submits the data required in the data summary table in the Product Chemistry Chapter (K. Dockter memo, 12/22/99) for the diclofop-methyl T/TGAI, and either certifies that the suppliers of beginning materials and the manufacturing process have not changed since the last comprehensive product chemistry review or submits a complete updated product chemistry data package, the Agency has no objections to the reregistration of diclofop-methyl with respect to product chemistry data requirements.

3.0 HAZARD CHARACTERIZATION

3.1 Hazard Profile

The toxicological database for diclofop-methyl is complete and will support reregistration. In summary, diclofop-methyl exhibits moderately low acute toxicity via the oral and dermal routes of exposure (toxicity category II), but is less toxic by the inhalation route of exposure (toxicity category IV). In primary irritation studies, diclofop-methyl produced moderate ocular irritation (toxicity category III) and slight dermal irritation (toxicity category IV).

Developmental toxicity studies were conducted in the rat and rabbit. In the rat study, developmental toxicity was observed only at maternally toxic doses. Systemic maternal toxicity was observed at the lowest dose tested and consisted of increased absolute and relative liver weights. At the mid-dose level, decreased fetal body weight and decreased crown-rump length, distended ureters, and skeletal abnormalities were observed. In the rabbit study no developmental toxicity was seen; maternal toxicity, consisting of increased liver and kidney weights, decreased body weights, and reduced food consumption, was observed only at the high-dose.

Subchronic feeding and dermal toxicity studies in the mouse and/or rat, the chronic toxicity/oncogenicity studies in the rat and mouse, and the two-generation reproduction study in the rat have all identified the liver as the target organ for toxicity. Liver weights were increased in treated animals in all of these studies. In the two-generation study, increased liver weights were observed across generations in both sexes; in some cases, pup liver weights were also affected. Histological examination of the livers revealed an increased incidence of hepatic lesions following subchronic oral and dermal exposure and multi-generational exposure. Carcinogenicity studies in the rat and mouse showed increased incidence of adenomas and carcinomas of the liver. No evidence of mutagenicity was seen in any study.

There is growing evidence that the observed hepatic carcinogenicity in the rat and mouse is a result of peroxisome proliferation. Most other pesticides in the same chemical class (diphenyl ethers) as diclofop-methyl are also carcinogenic and also produce peroxisome proliferation. Although detailed mechanistic studies have not been carried out with diclofop-methyl, the

subchronic toxicity studies in the rat and mouse included measurement of enzyme activities used as indirect markers for peroxisome proliferation. In these studies, malic enzyme and catalase were markedly increased during treatment, but returned to control levels after a treatment-free period. In the chronic toxicity study, electron micrographs showed an increase in the number of peroxisomes in the livers of treated rats.

Based on hepatocarcinogenesis in the mouse carcinogenicity study, the Agency's Cancer Assessment Review Committee classified diclofop-methyl as a Group C carcinogen (possible human carcinogen) with a Q_1* of 2.3 x 10^{-1} $(mg/kg/day)^{-1}$. The CARC met again on January 5, 2000 to review an acceptable combined chronic toxicity/carcinogenicity study in the rat and confirmed that the Q_1* of 2.3 x 10^{-1} $(mg/kg/day)^{-1}$ was appropriate for risk assessment.

The acute toxicity values for diclofop-methyl are presented in Table 1 below. Table 2 presents a subchronic and chronic toxicity profile of diclofop-methyl (technical).

Table 1: Acute Toxicity of Technical Diclofop-Methyl

Study Type	Animal	Results	Tox Cat	MRID No.
81-1: Acute Oral (LD_{50})	Rat	Male: 481 mg/kg Female: 500-630 (estimate) mg/kg Combined 512 (428-636) mg/kg	II	41476001 92036052
		Male: 580 mg/kg	III	00123982
		Female: 557 mg/kg	III	00123983
81-2: Acute Dermal (LD_{50})	Rat	Male and Female: > 2000 mg/kg	III	00071522 92036013
81-3: Acute Inhalation (LC_{50})	Rat	Male and female > 3.83 mg/L	IV	00032595
		Male and female > 4.75 mg/L	IV	41573304
		Male and female > 3.83 mg/L	IV	00032595
81-4: Primary Eye Irritation	Rabbit	Slight ocular irritant, Conjunctival redness and discharge at 24 hr, cleared by 72hr	III	42428601
81-5: Primary Dermal Irritation	Rabbit	Slight irritant, PII = 0.8 (0 to 72 hr)	IV	40213506
81-6: Dermal Sensitization	Guinea Pig	Buehler: Negative	NA	41476003 92036047
		Maximization: Moderate to severe sensitizer	NA	41476002 41476003 92036046

Table 2: Subchronic and Chronic Toxicity Profile of Technical Diclofop-Methyl

Study Type	NOAEL	LOAEL
82-1(a): 90-Day Feeding - Rat **MRID No.: 42573301 / 02** **HED Doc No.: 010435 (20 Jul 93)** **Acceptable (Guideline)**	**NOAEL (M/F): 1.6 / 1.8**	**LOAEL (M/F): 6.3 / 7.1** **Clinical chem, perox proliferation, liver hypertrophy**
82-1(a): 90-Day Feeding - Mouse **MRID No.: 42593901** **HED Doc No.: 010435 (9 Jul 93)** **Acceptable**	**NOAEL (M/F): Not established**	**LOAEL (M/F): 0.3 / 0.4** **Clinical chem, perox proliferation, liver necrosis**
82-2: 21-Day Dermal - Rat **MRID No.: 92036048 , 41476004** **HED Doc No.: 013723** **Acceptable**	**Syst NOAEL: 5** **Dermal NOAEL ≥125 mg/kg/day**	**Syst LOAEL: 25** **Based on increased liver enzymes, proteins, and absolute and relative liver weights** **Dermal LOAEL > 125 mg/kg/day**
83-1/2: Chronic Feeding/ Carcinogenicity - Rats **MRID: 43927302** **HED Doc: 013313** **Acceptable**	**Syst NOAEL (M/F): 0.23 / 0.3**	**Syst LOAEL (M/F): 2.32 /3.05** **Increased liver and kidney weights, hepatocellular hypertorphy, histopathology (lipofusin storage)**
83-1/2: Chronic Feeding/ Carcinogenicity - Rats **MRID: 92036057 (Reformat of 00070615)** **HED Doc: 008541 (1 Jul 91)** **83-1 Acceptable (guideline)** **83-2 Unacceptable (guideline)**	**Syst NOAEL (M/F): 1.6**	**Syst LOAEL (M/F): 19** **Increased relative liver, heart and kidney weights.**
83-1: 15-Month Feeding - Dog **MRID: 92036039 (reformat of 00071913)** **HED Doc No.: 008541 (21 Feb 91)** **Acceptable (guideline)**	**NOAEL (M/F): 2.0 / 0.2**	**LOAEL (M/F): not established / 0.63** **Clinical chem, perox proliferation, liver histopathology**
83-2: Carcinogenicity - Mice **MRID: 92036058 (Reformat of 00071870)** **HED DOC : 008541 (19 Mar 91)** **Acceptable (guideline)**	**NOAEL (M/F): 0.24 / 0.25**	**LOAEL (M/F): 0.76 / 0.77** **Clinical chem, perox proliferation, liver hypertrophy**
83-3(a): Developmental Tox - Rat **MRID No.: 92036042 (Reformat of 00071908)** **HED Doc: 008541, 010486 (Hist control)** **Acceptable (guideline)**	**Maternal NOAEL: not established** **Devel NOAEL 10**	**Syst LOAEL: 10 mg/kg/day** **Increased liver weights** **Devel LOAEL: 32** **Decreased fetal body weights and crown-rump length, distended ureters, skeletal abnormalities**
83-3(b): Developmental Tox - Rabbit **MRID No.: 92036043 (Phase III reformat of 00139613)** **HED Doc: 004312** **Acceptable (guideline)**	**Maternal NOAEL = 0.30 mg/kg/day** **Devel NOAEL ≥ 3.0 mg/kg/day**	**Maternal LOAEL = 3.0 mg/kg/day,** **Based on significantly increased absolute liver and kidney weights, decreased body weight gain, and reduced food consumption.** **No treatment-related developmental effects were noted at any dose level.** **The developmental LOAEL was not established.**

Study Type	NOAEL	LOAEL
83-4: 2-Generation Reproduction - Rat **MRID: 42543101, 42060501** **HED Doc: 011072 (13 Jun 94)** **Acceptable (guideline)**	**Syst NOAEL = 10 ppm** **(0.7 mg/kg/day, males** **0.9 mg/kg/day, females)** **Repro NOAEL = 30 ppm** **(2.1 mg/kg/day, males** **2.5 mg/kg/day, females)**	**Syst LOAEL = 30 ppm (2.1 mg/kg/day, males; 2.5 mg/kg/day, females)** **Based on liver weight increases and histopathological lesions in liver and kidney.** **Repro LOAEL = 100 ppm (7.3 mg/kg/day, males; 8.4 mg/kg/day, females** **Based on reduced fetal body weights and delayed physical development.**
870.5100: Bacterial reverse mutation test in *Salmonella typhimurim* **MRID: 00071904** **HED Doc: 000076**	**Dose range: 0 to 5000 g/mL +/- S9** **Negative for mutagenic effects** **Acceptable (Guideline)**	
870.5300: In vitro mammalian cell gene mutation test with Chinese hamster V79 cells **MRID: 41573305** **HED Doc: 008541**	**Dose range: 2 to 500 g/mL +/- S9** **Test was negative up to cytotoxic doses (≥ 200 g/mL, -S9; ≥ 300 g/mL, +S9).** **Acceptable (Guideline)**	
870.5375: In vitro mammalian chromosomal aberration test in primary human lymphocytes **MRID 41476004** **HED 013723**	**Dose range: 1 to 500 g/mL +/- S9** **Test was negative over the dose range +S9)** **Acceptable (Guideline)**	
870.5385: In vitro cytogenetic test in bone marrow cells of the Chinese hamster **MRID 41737901** **HED 008850**	**Dose range: 0, 200, 1000, and 2000 mg/kg** **Chromosomal analysis did not show any treatment-related cytogenetic aberrations** **Acceptable (Guideline)**	
870.5550: UDS Assay in primary rat hepatocytes in vitro **MRID: 00087816** **HED Doc: 001422**	**Dose range: 0.5 to 50 g/mL, cytotoxicity at 100 g/mL** **Did not induce significant increases in nuclear labeling of primary rat hepatocytes.** **Acceptable (Guideline)**	
870.5550: Unscheduled DNA synthesis in A549 human lung carcinoma in vitro **MRID: 41996902, 42437801** **HED Doc: 008796**	**Dose range: 0.03 to 100 g/mL ± S9** **Did not induce significant increases in nuclear labeling human lung cancer cells.** **Acceptable (Guideline)**	
: Mutagenicity -Other genotoxic effects **MRID: 00087820** **HED Doc: 001422**	**Dose range: 250, 500, 1000 g/mL ± S9** **Mitotic gene conversions not increased in yeast strain over spontaneous rate ± S9** **Acceptable (Guideline)**	
85-1: Metabolism - Rat **MRID No.: 41573306** **HED Doc No.: 008541**	**Acceptable**	
85-2: Dermal Absorption w/ 3EW & 3EC - Rat **MRID No.: 42364601** **HED Doc No.: 010334 (21 Sep 92)**	**Dermal absorption factor = 15% at 10 hours**	

3.2 FQPA Considerations

On April 10, 2000, the FQPA Safety Factor Committee met to evaluate the hazard and exposure data for diclofop-methyl, and recommended that the FQPA Safety Factor for the protection of infants and children be reduced to 1X for the following reasons (Memorandum: Report of the FQPA Safety Factor Committee, Brenda Tarplee, 04/24/00):

- The toxicology database is complete for the assessment of the effects following *in utero*

and/or postnatal exposure to diclofop-methyl

- There is no indication of quantitative or qualitative increased susceptibility of rats or rabbits to *in utero* and/or postnatal exposure to diclofop-methyl in the available toxicity data

- The HIARC determined that a developmental neurotoxicity study is not required for diclofop-methyl

- The dietary (food and drinking water) and non-dietary exposure assessments will not underestimate the potential exposures for infants and children from the use of diclofop-methyl

3.3 Endpoint Selection

On December 7, 1999, the Hazard Identification Assessment Review Committee (HIARC) evaluated the toxicology database for diclofop-methyl and selected toxicological endpoints for acute dietary, chronic dietary, and occupational (dermal and inhalation) exposure risk assessments pursuant to FQPA.

On July 25, 2000, the HIARC considered the merit of the registrant's (Aventis') proposed use of a 90-day feeding study in the rat in establishing the endpoints for short-and intermediate-term inhalation exposure. The HIARC concurred with the registrant's proposal (Memorandum: Third Report of the Hazard Identification Assessment Review Committee, Robert Fricke, 08/01/00).

The acute reference dose (RfD) of 0.1 mg/kg/day for females 13-50 years old is derived from the developmental toxicity study in the rat, and was calculated as the No-Observed-Adverse-Effect-Level (NOAEL) (10 mg/kg/day) divided by an UF of 100X (10X for interspecies extrapolation and 10X for intraspecies variability). The acute endpoint was based on significant decreases in fetal body weight and crown-rump length, distended ureters, and skeletal abnormalities at the Lowest-Observed-Adverse-Effect-Level (LOAEL) of 32 mg/kg/day. The study and endpoint selected are considered appropriate since it is assumed that the fetal effects could have resulted from a single exposure *in utero*. Since the FQPA safety factor was reduced to 1X, the acute RfD is equal to the aPAD.

The LOAEL for maternal systemic toxicity was established at 10 mg/kg/day. A NOAEL was not established. The LOAEL for developmental toxicity was established at 32 mg/kg/day; the NOAEL was established at 10 mg/kg/day.

No appropriate endpoint was identified for the U.S. general population, including infants and children. There were no effects observed in oral toxicology studies (including maternal toxicity in the developmental toxicity studies in rats and rabbits) that are attributable to a single exposure (dose).

The chronic RfD of 0.0023 mg/kg/day is derived from a combined chronic feeding/carcinogenicity study in the rat, and was calculated as the NOAEL (0.23 mg/kg/day) divided by an UF of 100X (10X for interspecies extrapolation and 10X for intraspecies variability). The chronic endpoint was based on increased absolute and relative liver and kidney weights, increased ALT (alanine aminotransferase), AST (aspartate aminotransferase), and AlkP (alkaline phosphatase) activities, impaired lipid and protein metabolism, and histopathology (hypertrophy, lipofuscin storage) in males and females at the LOAEL of 2.3 mg/kg/day. Since the FQPA safety factor was reduced to 1X, the chronic RfD is equal to the cPAD.

The short- and intermediate-term dermal NOAEL of 5 mg/kg/day is derived from a 21-day dermal toxicity study in the rat, and is based on increased liver enzymes, proteins, and absolute and relative liver weights at the LOAEL of 25 mg/kg/day. The UF for short- and intermediate-term dermal endpoints is based on 10X for interspecies extrapolation and 10X for intraspecies variability. The use pattern for diclofop-methyl (application rate of 454 g a.i./acre, once/crop cycle) does not indicate the potential for long-term dermal exposure. Therefore, a long-term dermal endpoint was not selected.

A dermal absorption factor (after 10 hours of exposure) of 15% will be used to convert the oral dose to an equivalent dermal dose for the cancer risk assessment only. This factor is based on the results from the dermal absorption study, which measured two formulations of diclofop-methyl (Hoelon 3EW and 3EC).

The subchronic feeding study in the rat is appropriate for short- and intermediate-term inhalation risk assessment since the effect (liver toxicity) is consistent with the other studies in both rats and mice. The current use pattern for diclofop-methyl does not indicate a concern for long-term inhalation or dermal exposure.

The doses and toxicological endpoints selected for the various exposure scenarios are summarized in Table 3 below.

Table 3: Endpoints Selected for Risk Assessment Purposes

EXPOSURE SCENARIO	DOSE (mg/kg/day)	ENDPOINT	STUDY
Acute Dietary (Females 13 - 50)	NOAEL = 10 mg/kg/day	Decreased fetal body wts, distended ureters, skeletal abnormalities. These effects could be attributed to a single dose.	870.3700 Developmental toxicity study in the rat (92036042)
	UF = 100	Acute PAD (RfD) = 0.1 mg/kg/day	

EXPOSURE SCENARIO	DOSE (mg/kg/day)	ENDPOINT	STUDY
Acute Dietary (General Population including Infants and Children)	None	No endpoint selected	None
Chronic Dietary (Non-cancer)	NOAEL = 0.23 mg/kg/day	Based on increased relative liver and kidney wts, liver enzymes, liver histopathology (hypertrophy, lipofuscin storage). Effects and NOAEL consistent with other studies in mouse and dog.	870.4300 Chronic toxicity study in the rat (43927302)
	UF = 100	Chronic PAD (RfD) = 0.0023 mg/kg/day	
Short-Term (Dermal)	NOAEL = 5 mg/kg/day UF = 100	Based on increased liver enzymes, proteins, and absolute and relative liver weights.	870.3200 21-Day Dermal Toxicity Study in the Rat (41476004)
Intermediate-Term (Dermal)	NOAEL = 5 mg/kg/day UF = 100	Based on increased liver enzymes, proteins, and absolute and relative liver weights.	870.3200 21-Day Dermal Toxicity Study in the Rat (41476004)
Long-term Non-cancer (Dermal)	Based on the use pattern, this risk assessment is not required		
Inhalation (Short- and Intermediate-term)	NOAEL = 1.6 mg/kg/day UF = 100	Based on increased liver enzymes, proteins, and absolute and relative liver weights.	870.3100 Subchronic Oral Toxicity Study in the Rat (42573301)
Inhalation (Long-term)	Based on the use pattern, this risk assessment is not required		
Cancer (Dermal and Inhalation)	Q_1* of 2.3×10^{-1} $(mg/kg/day)^{-1}$	Based on liver adenomas and carcinomas with significant trend and pair-wise comparisons.	870.4200 Mouse Carcinogenicity Study (92036058)

4.0 EXPOSURE CHARACTERIZATION

4.1 Registered Uses

Diclofop-methyl is a foliar contact herbicide that is registered for the control or suppression of wild oats and annual grasses in wheat and barley, as well as on established bermuda grass on golf courses. The use of diclofop-methyl on golf courses is subject to Section 24 © authorizations.

Specifically, diclofop-methyl is used for the control of: annual rye grass, broadleaf signal grass, crab grass, fall panicum, barnyard grass, water grass, foxtail grasses, goose grass, wild oats, itch grass, raoul grass, persian darnel, volunteer corn, witch grass (suppression), smallseed canary grass, and spring millet grass. Diclofop-methyl may be applied pre-emergent, post-emergent, foliarly, and pre-plant. Application is mainly by groundboom sprayer (over 90%) and by aerial equipment. A hand gun sprayer is used for spot treatment on golf courses. There is a maximum application rate of 1.0 lb/ai per acre for wheat and barley, 1.5 lb/ai per acre for golf courses, and one application per year.

Diclofop-methyl is sold in the United States by Aventis Crop Science under the trade names of Hoelon® and Illoxan®, and is formulated as a manufacturing product (93.0 percent a.i.) and as an emulsifiable concentrate (34.7 percent a.i.). There are no registered residential or non-agricultural uses of diclofop-methyl. However, there is the potential for non-occupational, post-application exposure to golfers and children over six years old who may accompany adults to treated golf courses.

4.2 Dietary Exposure

Tolerances have been established for the combined residues of diclofop-methyl and its metabolites 2-[4-(2,4-dichlorophenoxy)phenoxy]propanoic acid and 2-[4-(2,4-dichloro-5-hydroxyphenoxy)phenoxy]propanoic acid at 0.1 ppm in/on barley grain and straw and wheat grain and straw [40 CFR §180.385(a)]. Tolerances are also listed for lentils and peas (dry); however, these uses are no longer being supported by the registrant. Tolerances have been proposed for barley hay (6 ppm); wheat forage (12 ppm); wheat hay (1 ppm); meat by-products, excluding kidney (7 ppm); kidney (25 ppm); milk (4 ppm); and in the meat and fat of cattle, goat, horses, and sheep (1 ppm).

HED's MARC met on April 4, 2000 and determined the residues of concern for plant commodities are diclofop-methyl (parent), diclofop acid, and hydroxy diclofop and its conjugates. The residues of concern for animal commodities are diclofop-methyl and diclofop acid (free and conjugated). A conclusion was also made that diclofop-methyl (parent) and its metabolites should be considered toxicologically equivalent (S. Piper memo; 4/7/2000).

The qualitative nature of the residue in plants is understood based on an acceptable wheat metabolism study. The registrant must demonstrate that the enforcement method will convert M5 and M7 metabolites to 2-[4-(2,4-dichloro-hydroxyphenoxy)phenoxy]propanoic acid.

The qualitative nature of the residue in animals is adequately understood based on acceptable ruminant and poultry metabolism studies. Diclofop-methyl is metabolized similarly in ruminants and poultry. The residues of concern for both ruminants and poultry are diclofop-methyl and diclofop acid, free and conjugated. Regulation of hydroxy diclofop in animal matrices is not necessary since its concentration in animal tissues is relatively low.

Adequate methods are available for data collection and tolerance enforcement for plant and animal commodities. The Pesticide Analytical Manual (PAM) Vol. II lists a GLC/ECD method, designated as Method I, for the enforcement of tolerances for plant commodities. Method I determines residues of the parent and hydroxy diclofop. It does not specifically state it determines diclofop acid but this acid metabolite would likely be methylated to the parent in the methylation step. The stated detection limit of Method I is 0.05 ppm. The registrant has proposed a GC/ECD (or MSD) method, designated as Method BL/01/95 version 2, for the enforcement of the required animal commodity tolerances. The method determines residues of diclofop-methyl and diclofop acid (free and lipid conjugates) in meat, milk, and eggs. The validated limit of quantitation (LOQ) for residues of diclofop-methyl and diclofop acid in liver, fat, and eggs is 0.05 ppm. The LOQ for residues of diclofop-methyl and diclofop acid in milk is 0.01 ppm.

The reregistration requirements for multiresidue methods data are fulfilled. The FDA PESTDATA database dated 2/97 (PAM Volume I, Appendix I) indicates that diclofop-methyl is recovered (>80%) using Multiresidue Methods Sections 302 (Luke Method; Protocol D), 303 (Mills, Onley, and Gaither; Protocol E, nonfatty) and 304 (Mills; Protocol E, fatty food).

Adequate storage stability data indicate that residues of diclofop-methyl, diclofop acid, and hydroxy diclofop are stable under frozen (< 0 C) conditions in/on wheat matrices (grain, straw, bran, shorts, and flour) for at least 25 months. Adequate data are also available indicating that residues of diclofop-methyl and diclofop acid are stable in animal commodities (beef muscle, milk, poultry, liver, and eggs) stored at < -10 C for at least 23 months.

Acceptable magnitude of the residue in crop plants and processed food/feed studies, a ruminant feeding study, and a poultry feeding study have been submitted and evaluated by the Agency. There is no reasonable expectation of finding quantifiable diclofop-methyl residues of concern in eggs, fat, meat, and meat by-products of poultry; therefore, tolerances are not required for residues of diclofop-methyl in eggs and poultry tissues.

The submitted confined rotational crop study was deemed adequate, pending submission of sample storage information and storage stability data. The available study supported a 120-day restriction on planting root and tuber vegetables, leafy vegetables, and small grains of rotational crops in diclofop-methyl treated soils. If the registrant decides to support a 30-day plant-back interval, the Agency requires identification and characterization of extracted radioactive residues (>10% of the TRR, or total radioactive residues) from lettuce and barley forage.

In a letter submitted to the Agency, Aventis responded to the above-mentioned deficiencies of the confined rotational crop study. As a result of additional information provided by the registrant, the Agency now supports a 30-day plant-back interval for root and tuber vegetables, leafy vegetables, and small grains rotated into diclofop-methyl treated soils. No crop rotation restriction is required on diclofop-methyl labels (S. Piper memo; 07/24/2000).

A summary of diclofop-methyl tolerance reassessments can be found in the attached Residue

Chemistry Chapter (S. Piper memo, 05/02/2000). In summary, the Agency recommends that 40 CFR §180.385(a) be further subdivided into 40 CFR §180.385(a)(1) and 40 CFR §180.385(a)(2) for separate designations of diclofop-methyl residues of concern in plants and animals, respectively. Tolerances must be proposed for barley hay, wheat forage, and wheat hay under 40 CFR §180.385(a)(1). Tolerances should be established in milk and livestock commodities (cattle, goats, horses, and sheep) under 40 CFR §180.385(a)(2).

No maximum residue limits for diclofop-methyl have been established or proposed by International Codex for any agricultural commodity. Therefore, no compatibility questions exist with respect to U.S. tolerances.

4.2.1 Food Exposure

Dietary risk assessment for diclofop-methyl is based on estimates of diclofop-methyl and/or its metabolites that may occur in barley grain and wheat grain and also considers the possible occurrence in milk or animal tissues due to the feeding of treated grain, hay, or forage.

Submitted Data: Dietary risk assessment for diclofop-methyl is based, in part, on magnitude of the residue (field trial data) and processing studies submitted by the registrant in support of the reregistration of wheat and barley grain, hay, and forage. Dietary risk assessment for diclofop-methyl is also based on submitted ruminant and poultry feeding studies that establish the level of residue transfer to animal tissue, milk, and eggs.

Monitoring Data: The USDA PDP sampled wheat grain for diclofop-methyl in 1995 (600 samples), 1996 (340 samples), and 1997 (623 samples). Of these samples, there are two detections reported at 0.009 ppm and 0.01 ppm. The Limit of Detection (LOD) is listed at 0.006 ppm for all samples/years. Soybean grain was also monitored by the PDP in 1997 and 1998, with no detections of diclofop-methyl.

FDA domestic surveillance data (years 1992-1998) is also available for diclofop-methyl residue in whole grain barley, whole grain wheat, processed wheat commodities, whole milk, and milk products including cream and cheese. There are no reported detections of diclofop-methyl in any samples. Data indicate the Limit of Quantitation (LOQ) for FDA milk samples does not exceed 0.01 ppm. There is no FDA surveillance data for diclofop-methyl residue in animal tissue.

Usage Data: Annual usage of diclofop-methyl has been estimated by the Biological and Economic Analysis Division (BEAD) based on EPA, USDA/NASS, NCFAP, and other data sources (Quantitative Usage Analysis, A. Halvorson, 2/17/99 and 4/21/2000). Use estimates were revised by BEAD on 7/14/2000 (personal communication V. Dietrich to R. Griffin, 7/14/2000).

Diclofop-methyl is estimated to be currently used less than 1% (0.5%) of the total U.S. barley crop. Diclofop-methyl usage on wheat varies somewhat according to variety, with an estimated use of 1.2% used on winter wheat (winter wheat accounts for approximately 50% of total wheat

produced), 0.4% use on spring wheat, and an estimated 12% use on durum wheat (durum wheat accounts for <4% of total wheat production). Total usage on wheat is estimated to be less than 2% of all wheat grown in the U.S.

It should be noted that >90% of diclofop-methyl usage is a post-emergence use which in turn leads to considerations for livestock exposure via foraging of treated wheat. However, chronic risk assessment for diclofop-methyl in milk is based on the expert opinion that, at most, 15% of dairy cattle may consume wheat forage (personal communication D. Putnam to V. Dietrich, 7/17/2000). Data indicate that barley is not a significant forage item.

The registrant has reported, and Agency data confirm, that there has been an overall decline of diclofop-methyl usage due to the introduction of other herbicides.

Residue Estimates for Acute Risk Assessment

Wheat/Barley Grain: The combined residues of diclofop-methyl and its metabolites, diclofop acid and hydroxy diclofop were nondetectable (< 0.10 ppm) in field trial studies in/on wheat and barley grain. Wheat and barley processing data demonstrate that residues of diclofop-methyl and its metabolites, diclofop acid and hydroxy diclofop, do not concentrate in bran, flour, or other processed fractions following postemergence foliar application at 5x the label rate.

Since wheat and barley grain are blended commodities and processed prior to consumption, the residue estimate for risk assessment is based on ½ the LOQ (0.05 ppm in field trial studies), a (reduction) factor of 0.2 based on processing data at 5x label rate, and finally factored for the (rounded up) percent of total crop treated (1% for barley and 2% for wheat). On this basis, the residue estimates for acute risk assessment are 0.0002 ppm for wheat grain and 0.0001 ppm for barley grain.

Since barley and wheat grain are highly blended commodities, the extrapolated values were selected for risk assessment, with the monitoring data serving as confirmation of the estimates used.

Animal Tissues: Metabolism studies have demonstrated a transfer of diclofop-methyl and diclofop acid to animal tissue (meats/fat/internal organs). Lacking monitoring data for these commodities, this aspect of the acute dietary risk assessment relies on extrapolated residue levels, based on an estimate of the possible exposure, or burden, to livestock from treated items, and transfer factors derived from ruminant and poultry feeding studies. Data from the poultry feeding study and an estimate of a low dietary residue burden for poultry led to a decision that a tolerance is not required for eggs or other poultry products. On the same basis, poultry products have also been dropped from the dietary risk assessment.

A dietary burden reflecting a theoretical maximum exposure to diclofop-methyl for beef cattle (extrapolated to goats and sheep) and swine, is based on the feed items of wheat grain, wheat

forage, and barley hay (and for acute assessment assumes 100% treatment of each item). Residue estimates for wheat forage (the most significant contribution to the diclofop-methyl dietary burden) are based on field trial measurements at day 26 following postemergence treatment. Although residue measurements for forage at day 10 following application were used to establish tolerances, the 26-day interval from application to foraging is considered a better estimate of actual agricultural practices and more suitable for risk assessment. From this data, a dietary burden of 1.86 ppm was established for beef cattle and a dietary burden of 0.045 ppm established for swine, based on wheat grain only.

Ruminant feeding study data were used to derive estimates of residue transfer from plant feed items to liver, kidney, fat, and muscle of beef cattle, and swine tissue (see Table 4, *Poultry and Ruminant Feeding Studies for Diclofop-Methyl*. S. Piper, 2/29/2000). Since the assessment is for acute, or maximum, exposure the highest measured residue from the feeding study dose level most closely corresponding to the estimated dietary burden (1.86 ppm) was used to calculate the final transfer factor for each of the above tissues.

Based on the data outlined above (residue burden x transfer factor), the residue estimates for acute dietary risk from ruminant tissues are: 0.046 ppm in meat/byproducts, 0.13 ppm in fat, 0.84 ppm in kidneys, and 0.22 ppm in liver. Swine tissue residue estimates, which are based on wheat grain only, are assessed at: 0.001 ppm in meat/byproducts, 0.003 ppm in fat, 0.02 ppm in kidney, and 0.0054 ppm in liver.

Table 4: Dietary Burden Estimates

Feed Commodity	% Dry Matter[a]	% Diet	Residues (ppm)[c]	Dietary Contribution (ppm)[b]
Beef Cattle				
Wheat forage	25	25	1.77[d]	1.77
Barley hay	88	25	0.22[e]	0.062
Wheat grain	89	50	0.05	0.028
TOTAL BURDEN		100		1.86
Dairy Cattle				
Wheat forage	25	42	1.24[d]	2.08
Barley hay	88	28	0.16[e]	0.052
Wheat grain	89	30	0.05	0.01
TOTAL BURDEN		100		2.15
Swine				
Wheat grain	89	80	0.05	0.045
TOTAL BURDEN		80		0.045

Feed Commodity	% Dry Matter[a]	% Diet	Residues (ppm)[c]	Dietary Contribution (ppm) [b]
a= OPPTS Guideline 860.1000 b= Contribution = [residue / % DM (if cattle)] x % diet. c= Anticipated residue. d= HAFT (Highest Average Field Trial) at 26-day PHI from field trials. e= average residues from field trials.				

Milk: Although extensive FDA surveillance monitoring data is listed for diclofop-methyl in milk and milk products (with no detections of diclofop-methyl or metabolites), a decision was made to not use FDA data for risk assessment. This decision was made because it could not be determined if the FDA method identified the metabolite expected in milk.

The dietary burden for dairy cattle was estimated as above, except averaged residues from field trial studies were used instead of maximum residues to account for the blending that occurs in milk processing. Transfer factors were based on averaged residues from the feeding study dose level most closely corresponding to the estimated dietary burden of 2.12 ppm.

Based on the data outlined above (residue burden x transfer factor), the residue estimates for acute dietary risk from dairy products is 0.22 ppm in whole milk (0.22 ppm is entered for each milk category in the DEEM program: non-fat solids, fat solids, sugar, and water).

Residue Estimates for Chronic Risk Assessment

Wheat/Barley Grain: The combined residues of diclofop-methyl and its metabolites, diclofop acid and hydroxy diclofop were nondetectable (<0.10 ppm) in/on wheat and barley grain in field trial studies. Wheat and barley processing data demonstrate that residues of diclofop-methyl and its metabolites, diclofop acid and hydroxy diclofop, do not concentrate in bran, flour, etc. following post-emergence foliar application at 5x the label rate. Since wheat and barley grain are blended commodities, the residue estimate for risk assessment is based on ½ the LOD (0.05 ppm in field trial studies), a reduction factor of 0.2 based on processing data at 5x label rate, and factored for the percent of total crop treated (2% for wheat and 0.5% for barley). On this basis, the residue estimates for chronic risk assessment are 0.00005 ppm for barley grain (and processed commodities) and 0.0002 ppm for wheat grain (and processed commodities).

Animal Tissues: Residue estimates for chronic risk assessment for ruminant meats (and pork) were derived from the estimates summarized above for acute risk assessment. However, each acute residue estimate has been factored for percent crop treated data, with the intent to more accurately reflect the variations of exposure expected over the long-term (cancer risk is based on the assumed lifetime exposure).

Based on the data outlined above (residue burden x transfer factor x percent crop treated) the residue estimates for chronic dietary risk from residues in ruminant tissues are: 0.0009 ppm in

meat/byproducts, 0.0025 ppm in fat, 0.017 ppm in kidney, and 0.004 ppm in liver. Swine tissues are estimated at: 0.00002 ppm in meat/meat byproducts, 0.00004 ppm in fat, 0.0004 ppm in kidney, and 0.00009 ppm in liver.

Milk: Residue estimates for the chronic risk assessment for milk (and milk products) were derived from the residue estimates summarized above for the acute assessment. However, estimates for chronic risk assessment were factored for percent crop treated (1.6% for wheat forage) and for the estimated percent of total dairy cattle that may forage spring or winter wheat. The estimate for dairy cattle foraging, believed to be an upper-bound estimate, is 15% of total dairy cattle.

Based on the data outlined above (average residue burden x average transfer factor x percent crop treated x percent forage), the reside estimate for chronic dietary risk from milk and milk products is: 0.0005 ppm (0.0005 ppm is entered for each milk category in the DEEM program: non-fat solids, fat solids, sugar, and water).

Food Consumption Estimates/DEEM™ Software

The Agency is currently using the *Dietary Exposure Evaluation Model* software, or DEEM™, to calculate acute and chronic dietary risk estimates for the general U.S. population and defined population subgroups, including infants and children. Food consumption data used in the program is based on the *USDA Continuing Survey of Food Intake by Individuals* (CSFII). The Agency is currently using the CSFII 1989-92 consumption data, which is based on the reported food consumption of 10,383 individuals over a three day interval. Foods "as eaten" (such as cherry pie) are linked to Raw Agricultural Commodities such as cherries, wheat, oil, etc. by the use of recipe translation files.

Chronic dietary exposure estimates are based on averaged consumption data for the entire U.S. population, and within population subgroups such as "all infants." For this assessment, the averaged consumption estimate of each population group is multiplied by residue estimates outlined above for wheat/barley grain, livestock tissue, and milk. Chronic dietary exposure estimates are calculated by the DEEM™ program in mg/kg body weight/day, and chronic dietary risk is calculated as a percent of the cPAD.

Acute dietary exposure estimates are *not* based on averaged consumption data. Instead, the program references each individual record of consumption and produces a distribution (from the 10th to the 99.9th exposure percentile) of daily exposures for individuals comprising the U.S. population and/or population subgroups (for this assessment, females 13-50 years of age). Acute dietary exposure estimates are calculated by the DEEM™ program in mg/kg body weight/day and risk is calculated as a percent of the aPAD.

4.2.1.1 Acute Dietary Exposure Assessment

The DEEM™ model was used to calculate acute dietary exposure estimates based on total single-

day consumption data. Based on the residue and consumption data outlined above, the DEEM™ program estimates that the population subgroup of U.S. females (ages 13-50) are acutely exposed to diclofop-methyl at a level that is less than 8% (at the 99.9% exposure percentile) of the respective aPAD (R. Griffin memo, 08/03/2000).

4.2.1.2 Chronic Dietary Exposure Assessment

The DEEM™ model was used to calculate chronic dietary exposure estimates based on average consumption data for the U.S. population and U.S. population subgroups including infants and children. Based on the residue and percent crop treated data outlined above, the DEEM™ model estimates that all population subgroups, including infants and children, are chronically exposed to diclofop-methyl at a level less than, or equal to, 1% of the respective cPAD (R. Griffin memo, 08/03/2000). Table 5 presents a summary of acute and chronic dietary risks to diclofop-methyl.

Table 5: Tier 3 Acute and Chronic Dietary Risk Estimates

Population	Chronic Dietary		Acute Dietary (99.9th percentile)	
	Exposure (mg/kg/d)	% cPAD	Exposure (mg/kg/d)	% aPAD
U.S. General Population	0.000005	<1%	n/a	n/a
Children (1-6 years)	0.000016	<1%	n/a	n/a
All infants (< 1 year)	0.000007	<1%	n/a	n/a
Females (13-50)	0.000003	<1%	0.007558	<8%

n/a = not applicable

4.2.1.3 Carcinogenic Risk

Carcinogenic risk for diclofop-methyl is quantified, based on the estimated average dietary exposure of the general U.S. population (0.000005 mg/kg bw/day) multiplied by the upper-bound potency factor (Q_1*) of 2.3 x10^{-1} (mg/kg/day)$^{-1}$. On this basis, the upper-bound carcinogenic risk estimate for diclofop-methyl is calculated to be 1.2 x 10^{-6}, which is the level generally considered negligible by the Agency (1 x 10^{-6}).

4.2.2 Drinking Water Exposure

The Environmental Fate and Effects Division (EFED) has provided a refined surface water and a Tier 1 groundwater analysis for diclofop-methyl, using computer modeling, existing monitoring data, and a small scale prospective groundwater study (S. Dutta memo, 10/14/99). Estimated environmental concentrations (EECs) of diclofop-methyl in drinking water were calculated using PRZM/EXAMS (Tier 2 surface water), SCI-GROW2 (Tier 1 groundwater), and

some surface and groundwater monitoring data from the STORET data base. The limit of detection of the monitoring data is 0.1 ppb.

Diclofop-methyl is not expected to reach ground or surface water in significant quantities under most conditions. If it were to reach surface water, it is expected to degrade rapidly by microbial metabolism. If diclofop-methyl were to reach groundwater, it could possibly persist due to potentially low microbial activity. Biodegradation is the only apparent means of diclofop-methyl dissipation. Parent diclofop-methyl degrades rapidly in aerobic soil ($T_{1/2}$ 1 day) to its acid metabolite, diclofop acid. Diclofop-methyl and its acid metabolite degraded with an estimated half life of 21 to 51.3 days in four aerobically incubated soils. Under anaerobic conditions, diclofop-methyl also degrades rapidly to diclofop acid. Diclofop acid was extremely persistent under anaerobic conditions with a half life of greater than 60 days. Under almost all uses, degradation is expected to be so rapid that diclofop-methyl will not have time to move in soil. Its low solubility in water (3 mg/L) also causes it to be less mobile in soil.

The residues of concern for drinking water are diclofop-methyl and its metabolite, 2-[4-(2,4-dichlorophenoxy)phenoxy]propanoic acid. PRZM/EXAMS and SCI-GROW modeling estimates, as well as monitoring data from the prospective groundwater study, are based on parent diclofop-methyl and its acid metabolite.

Surface water: For drinking water originating in surface water bodies, an **acute** concentration of 1.466 g/l was used to evaluate the risk to human health. This value is based on the maximum (upper 90th) percentile concentration calculated using PRZM-EXAMS. A **chronic** value of 0.097 g/l was used to evaluate the chronic and cancer risk to human health. This value is based on the 10 year annual mean concentration calculated using PRZM-EXAMS.

Groundwater: For drinking water derived from groundwater, a value of 0.067 g/l was used to evaluate acute, chronic, and cancer risks to human health. This value is based on the SCI-GROW2 model and assumes one application per season of 1 lb ai/acre. A prospective groundwater study indicates that at 48 days after treatment, bromide tracers were detected in the shallow groundwater wells indicating recharge of aquifer; however, no diclofop-methyl or its acid metabolites were detected in the groundwater or soil water samples. Since the predicted concentration of diclofop-methyl in groundwater is below the limit of quantitation (1 g/l) of the prospective groundwater study, EFED cannot predict with certainty whether diclofop-methyl will reach groundwater. However, based on the environmental fate properties and the prospective groundwater study, neither diclofop-methyl nor its acid metabolite are expected to reach groundwater.

Monitoring Data: Some monitoring data were available in the STORET data base for diclofop-methyl and diclofop acid. All of the data were from Minnesota and Idaho only. Reported concentrations in the monitoring data were all below 0.1 g/l. Modeling results are considered to be conservative and are approximately an order of magnitude higher than the concentrations reported in the STORET monitoring data.

Drinking Water Levels of Comparison (DWLOCs): A DWLOC is a theoretical upper limit on a pesticide's concentration in drinking water in light of total aggregate exposure to a pesticide in food, drinking water, and through residential uses. The Office of Pesticide Programs uses DWLOCs internally in the risk assessment process as a surrogate measure of potential exposure associated with pesticide exposure through drinking water. DWLOC values are not regulatory standards for drinking water; however, they do have an indirect regulatory impact through aggregate exposure and risk assessments.

DWLOCs are calculated for each type of risk assessment and compared to the appropriate EEC of a pesticide in surface and groundwater, as provided by EFED. If the DWLOC is greater than the estimated surface and groundwater concentration, (i.e., if the DWLOC > EEC), the Agency concludes with reasonable certainty there is no drinking water risk of concern.

4.2.2.1 DWLOCs for Acute Exposure

Acute DWLOCs were calculated for diclofop-methyl based on acute dietary food exposure and default body weight and water consumption figures. The default body weight and daily water consumption value used to calculate the acute DWLOC for females 13-50 is as follows: 60 kg and 2 L/day. To calculate the acute DWLOC, the following equation was used:

$$DWLOC_{acute} (\ \mu g/L) = \frac{[\text{allowable acute water exposure (mg/kg/day)} \times \text{(kg body weight)}]}{[\text{consumption (L/day)} \times 10^{-3}\ \text{mg/}\ \mu g]}$$

where allowable acute water exposure (mg/kg/day) = [aPAD - acute food (mg/kg/day)].

As shown in Table 6 below, EFED's EECs of diclofop-methyl residues in surface and groundwater are below the Agency's back-calculated DWLOCs for females 13-50. Acute exposure to residues of diclofop-methyl in surface and groundwater is not of concern.

Table 6: Drinking Water Levels of Comparison for Acute Dietary Exposure

Acute Surface and Groundwater						
Population	**PRZM/EXAMS (g/L)**	**SCI-GROW (g/L)**	**aPAD (mg/kg/d)**	**Acute Food Exposure (mg/kg/d)**	**Allowable Acute Water Exposure (mg/kg/d)**	**$DWLOC_{acute}$ (g/L)**
Females (13-50)	1.47	0.067	0.1	0.007558	0.092442	3000

4.2.2.2 DWLOCs for Short-Term Exposure

Short-term DWLOCs were calculated for diclofop-methyl using the reciprocal MOE approach. This approach was selected as the target MOEs are identical for all MOEs in the equation.

$$\text{Aggregate MOE} = \frac{1}{\frac{1}{MOE_{FOOD}} + \frac{1}{MOE_{WATER}} + \frac{1}{MOE_{DERMAL}}}$$

Where the aggregate MOE is equal to the target MOE of 100; the MOE_{FOOD} is based on the dietary exposure from average food residues (chronic dietary exposure) compared to the short-term oral NOAEL of 1.6 mg/kg/day from the subchronic oral toxicity study in the rat; the MOE_{DERMAL} is based on the calculated high-end dermal non-occupational (golfer) exposures compared to the short-term dermal NOAEL of 5 mg/kg/day from the 21-day dermal toxicity study in the rat; and the MOE_{WATER} is based on allowable short-term water exposure from average drinking residues compared to the short-term oral NOAEL of 1.6 mg/kg/day for the subchronic oral toxicity study in the rat.

After solving for the term MOE_{WATER}, available short-term water exposure can be calculated as follows, where the short-term oral NOAEL is 1.6 mg/kg/day from a subchronic oral toxicity study in the rat.

$$MOE_{WATER} = \frac{\text{Short-term oral or acute dietary NOAEL}}{\text{Allowable Short-Term Water Exposure}}$$

Using the allowable short-term water exposure value, short-term DWLOC values are calculated as follows, using default body weight and water consumption values (70 kg/2 L for males, 60 kg/2 L for females; and 10 kg/1 L for children and infants):

$$DWLOC_{short\text{-}term} (\ g/L) = \frac{[\text{allowable short-term water exposure (mg/kg/day) x (kg body weight)}]}{[\text{consumption (L/day) x } 10^{-3}\ \text{mg/ g}]}$$

As shown in Table 7 below, EFED's EECs of diclofop-methyl residues in surface and groundwater are below the Agency's back-calculated short-term DWLOCs for all population subgroups. Short-term exposure to residues of diclofop-methyl in surface and groundwater is not of concern.

Table 7: Short-Term Drinking Water Levels of Comparison

Population	PRZM/ EXAMS (g/L)	SCI-GROW (g/L)	Dermal Exposure (mg/kg/d)	Chronic Food Exposure (mg/kg/d)	Allowable Short-Term Water Exposure (mg/kg/d)	$DWLOC_{short\text{-}term}$ (g/L)
U.S. Population	0.097	0.067	0.0036	0.000005	0.014842	500
Children (1-6)	0.097	0.067	0.0036	0.000016	0.014833	100
Females (13-50)	0.097	0.067	0.0036	0.000003	0.014845	400

4.2.2.3 DWLOCs for Chronic Exposure

Chronic DWLOCs were calculated for diclofop-methyl based on chronic dietary food exposure and default body weight and water consumption figures. The default body weights and daily water consumption values used to calculate DWLOCs are as follows: 70 kg/2 L (adult male), 60 kg/2 L (adult female), and 10 kg/1 L (children and infants). To calculate the chronic DWLOC, the following equation was used:

$$DWLOC_{chronic} (\ \ g/L) = \frac{[\text{allowable chronic water exposure (mg/kg/day) x (kg body weight)}]}{[\text{consumption (L/day) x } 10^{-3}\ \text{mg/ g}]}$$

where allowable chronic water exposure (mg/kg/day) = [cPAD - (chronic food exposure (mg/kg/day) + chronic non-occupational exposure (mg/kg/day))].

Based on the use pattern of diclofop-methyl, chronic non-occupational exposure to residues of diclofop-methyl is not expected. Therefore, the allowable chronic water exposure (mg/kg/day) = [cPAD - chronic food exposure (mg/kg/day)].

As shown in Table 8 below, EFED's EECs of diclofop-methyl residues in surface and groundwater are below the Agency's DWLOCs for all population subgroups of concern. Chronic exposure to residues of diclofop-methyl in surface and groundwater is not of concern.

Table 8: Drinking Water Levels of Comparison for Chronic Dietary Exposure

Chronic Surface and Groundwater

Population	PRZM/EXAMS (g/L)	SCI-GROW (g/L)	cPAD (mg/kg/d)	Chronic Food Exposure (mg/kg/d)	Allowable chronic Water Exposure (mg/kg/d)	$DWLOC_{chronic}$ (g/L)
U.S. Population	0.097	0.067	0.0023	0.000005	0.002295	80
Children (1-6)	0.097	0.067	0.0023	0.000016	0.002284	20
Females (13-50)	0.097	0.067	0.0023	0.000003	0.002297	70

4.2.2.4 DWLOCs for Cancer

The cancer DWLOC is the concentration of a pesticide in drinking water as a part of the aggregate chronic exposure that results in a negligible cancer risk (10^{-6}). The default body weight and daily water consumption value used to calculate the cancer DWLOC is as follows: 70 kg and 2 L/day. To calculate the $DWLOC_{cancer}$ the following equations are used:

$$DWLOC_{cancer}\ (ug/L) = \frac{\text{chronic water exposure (mg/kg/d) x body weight (kg)}}{\text{consumption (L/d) x } 10^{-3}\text{ mg/ug}}$$

where chronic water exposure (mg/kg/d) =

$$\frac{\text{Negligible Risk}}{Q_1^*} - \text{[average chronic food + non-occupational exposure (LADD) (mg/kg/d)]}$$

The cancer risk for post-application exposure to golfers (2.2×10^{-6}) is greater than the level generally considered negligible by the Agency (1×10^{-6}). Therefore, inclusion of post-application exposure to golfers in the $DWLOC_{cancer}$ calculation would result in an unacceptable contribution to cancer aggregate risk.

If post-application exposure to golfers is **not** factored into the above equation, cancer aggregate exposure can be calculated based on food and drinking water alone. The carcinogenic risk estimate for diclofop-methyl in the food supply (for the general U.S. population) is estimated to be 1.2×10^{-6}. Since this risk estimate is at the level (10^{-6}) generally considered negligible by the Agency, a $DWLOC_{cancer}$ was not calculated, as the DWLOC calculation assumes that dietary exposure is below the Agency's level of concern. Rather, the estimated concentration of diclofop-methyl in surface water, 0.097 g/L, was used to calculate a water exposure estimate of 2.8×10^{-7} mg/kg/day. When multiplied by the upper-bound potency factor (Q_1^*), this results in a drinking water cancer risk estimate of 6.4×10^{-7} mg/kg/day. When added to the dietary carcinogenic risk estimate of 1.2×10^{-6}, this results in a combined exposure of 1.8×10^{-6} from food and drinking water exposure. Although this value is greater than 1×10^{-6}, the Agency notes that the Q_1^* is an upper-bound potency factor, and water exposure estimates are based on ecological models, which may not reflect actual residue concentrations in drinking water.

The Agency concludes with reasonable certainty that residues of diclofop-methyl in drinking water, when considered along with exposure from food, will not result in an unacceptable cancer aggregate risk.

4.3 Occupational Exposure

4.3.1 Occupational Handler Exposure

The Agency has determined that occupational exposure to diclofop-methyl residues via the dermal and inhalation routes of exposure may occur during mixing, loading, applying, and other handler-use activities. Based on registered use patterns, seven major exposure scenarios have been identified for diclofop-methyl: (1) mixing/loading liquids for groundboom application; (2) mixing/loading liquids for aerial application; (3) mixing/loading liquids for hand gun sprayer application; (4) applying liquids with a groundboom sprayer; (5) applying liquids with a fixed-wing aircraft; (6) applying liquids with a hand gun sprayer; and (7) flagging for liquid applications.

The exposure scenarios are of short-term (1-7 days) and intermediate-term (one week to several months) duration only. No chronic occupational handler exposure scenarios (i.e., more than 180 days per year) have been identified for diclofop-methyl. The estimated exposures consider baseline protection (long pants; long sleeved shirt; no gloves; open mixing/loading; and open cab tractor), additional PPE (double layer of clothing; chemical resistant gloves; and a dust mist respirator), and engineering controls (closed mixing/loading; enclosed cab, cockpit, and truck; and water soluble packaging).

Chemical-specific exposure data for assessing human exposures during pesticide handling activities were not submitted to the Agency in the support of the reregistration of diclofop-methyl. It is Agency policy to use data from the Pesticide Handlers Exposure Database (PHED) Version 1.1 to assess handler exposures for regulatory actions when chemical specific monitoring data are not available. PHED is a software system consisting of two parts -- a database of measured exposure values for workers involved in the handling of pesticides under actual field conditions and a set of computer algorithms used to subset and statistically summarize the selected data. Currently, the database contains values for over 1,700 monitored individuals (i.e., replicates). While data from PHED provide the best available information on handler exposures, it should be noted that some aspects of the included studies (e.g., duration, acres treated, pounds of active ingredient handled) may not accurately represent labeled uses in all cases.

General assumptions used in the occupational handler exposure assessment include an average body weight of an adult handler as 70 kg and an average work day interval of eight hours. Each exposure scenario includes the allowable maximum application rate that was identified on available product labels. In addition, a range of application rates was used for golf courses. The daily acres treated are HED standard values; deviations from HED standard values include the use of 40 acres per day for groundboom application to golf courses.

General assumptions used in the occupational cancer risk assessment include an average body weight of 70 kg, a career duration of 35 years which represents a typical working lifetime, a lifetime of 70 years, 15% dermal absorption and 100% inhalation absorption, a Q_1* of 2.3×10^{-1} $(mg/kg/day)^{-1}$, and maximum PPE (coveralls and a dust/mist respirator). Two exposure frequencies were used for wheat and barley in the calculations: the first represents the maximum number of applications per site per year for private use (10 days), and the second frequency represents commercial handlers making multiple applications per site per year (20 days). For golf course workers, an exposure frequency of 10 days per year is assumed.

Several issues should be considered when interpretating the occupational exposure risk assessment. These include: the use of low quality PHED data for several handler assessments due to a lack of a more acceptable data set; the use of several generic protection factors for calculating handler exposures (e.g., 80 percent protection factor over baseline for inhalation unit exposure to account for the use of a dust/mist respirator); and the use of standard assumptions (e.g., acres treated per day, square feet applied, and gallons of liquid applied) that are based on the Agency's best professional judgement. It should be noted that estimates of acres treated per day have been supplied by the registrant and, while the registrant's estimates are mostly lower than Agency estimates, the magnitude of the differences are not considered sufficient to significantly impact the results of the assessment.

A summary of MOEs and cancer risks for occupational exposure to diclofop-methyl is presented in Appendix 1.

4.3.1.1 Non-Cancer Handler Risk Characterization

Dermal and inhalation NOAELs for diclofop-methyl were based on a common endpoint; therefore, the dermal and inhalation MOEs were combined to determine a total short-term MOE and a total intermediate-term MOE. Short-term MOEs represent exposure scenarios that are one to seven days in duration. Intermediate-term MOEs represent exposure scenarios that are one week to several months in duration. The target MOE for all scenarios is 100. A MOE greater than or equal to 100 is not considered to be of concern.

Baseline represents exposure wearing long pants, long sleeved shirts, no gloves, and open mixing/loading techniques. PPE represents exposure wearing long pants, long sleeved shirts, and gloves while using open mixing/loading systems and open cab tractors. If necessary, a dust/mist mask represented by a five-fold protection factor is added to mitigate the risks. Engineering controls represent exposure while wearing long pants, long sleeved shirts, no gloves (except chemical resistant gloves for closed loading systems) while using closed mixing/loading systems and enclosed cabs/cockpits.

Total short- and intermediate-term MOEs for non-cancer handler risk are not of concern (MOE $\geq$100) at the highest level of risk mitigation (PPE or engineering controls) for all scenarios. MOEs range from <1 to 535 at baseline; 60 to 2615 at PPE; and 110-760 at the engineering

control level. The value used for daily acres treated (350 acres) for scenarios (2) and (5) is based on HED's estimate of acreage that would be reasonably expected to be treated in a single day.

The PHED task force has evaluated all data within the system and developed a set of grading criteria to characterize the quality of the original study. Mixing/loading/applying liquids by groundboom scenario has a high quality grade; mixing/loading liquid for a hand gun sprayer has a high quality grade; applying liquid with a hand gun sprayer has a low quality grade; mixing/loading liquid for fixed-wing aircraft has a high quality grade; applying with a fixed wing aircraft has a low quality grade; and flagging for liquid application has a high quality grade.

4.3.1.2 Cancer Handler Risk Characterization

The cancer risk assessment for handlers uses a baseline exposure scenario and, as needed, increasing levels of risk mitigation (PPE and engineering controls) to achieve cancer risks that are not of concern. In general, the Agency is concerned when occupational cancer risk estimates exceed 1×10^{-4}. The Agency will seek ways to mitigate the risks, to the extent that it is practical and economically feasible, to a level of 1×10^{-6} or less.

For occupational handler exposure to diclofop-methyl, cancer risks range from 1.4×10^{-2} to 5.1×10^{-6} at the baseline level, 8.40×10^{-5} to 6.0×10^{-7} with PPE, and 5.8×10^{-5} to 1.4×10^{-6} at the engineering control level. Appendix 1 lists a summary of cancer risks to occupational handlers.

4.3.2 Occupational Post-Application Exposure

The Agency has determined that there are potential post-application exposures to occupational workers in the following scenarios: mowing/maintaining golf course turfgrass; and scouting of wheat and barley fields. Since harvesting wheat and barley is fully mechanized, there is low potential for exposure. Therefore, a quantitative risk assessment was not conducted for this scenario. Fully mechanized is defined as activities that eliminate the potential for pesticide exposure by physically separating the worker from anything that has been treated with the pesticide to which the restricted-entry interval applies. This includes, but is not limited to, soil, water, air, or surfaces of plants. These mechanized processes must meet the criteria described in the Worker Protection Standard for entry during a restricted entry interval (REI) for activities with "no contact."

No chemical specific post-application exposure studies were conducted by the registrant. Therefore, a surrogate post-application exposure assessment for golf course workers and golfers was conducted using assumptions presented in the Standard Operating Procedures (SOPs) for Residential Exposure Assessments (12/18/1997), as well as recommended approaches from HED's Exposure Scientific Advisory Council. These assumptions are still considered to be high-end, screening level assumptions.

The following assumptions were used in the calculations of occupational post-application risk:

dislodgeable foliar residue (DFR) values are assumed to be 20 percent of the application rate at day zero with a 10 percent daily dissipation rate for ornamental applications, and five percent of the application rate at day zero for turfgrass application; transfer coefficients are assumed to be 500 cm^2/hour for mowing and maintaining golf course turf and 100 cm^2/hour for scouting of wheat and barley; daily exposure is assumed to occur for eight hours per day for mowing and maintaining golf course turf and scouting wheat and barley; the average adult body weight is assumed to be 70 kg; exposure frequency is assumed to be four days/year for golf course mowing and 10 days/year for wheat and barley scouting (based on best professional judgement); exposure duration is assumed to be 35 years (a typical working lifetime), and lifetime is assumed to be 70 years. The Q_1* used in the post-application assessment is 2.3×10^{-1} $(mg/kg/day)^{-1}$.

A summary of the post-application MOEs and cancer risks is presented in Appendix 2.

4.3.2.1 Non-Cancer Post-Application Risk Characterization

Entry by golf course workers to mow and maintain golf course turf is acceptable on the day of application, as soon as the spray is dry. The MOE for this scenario is 105 at the maximum application rate of 1.5 lbs ai/acre. Entry by workers to wheat or barley for scouting is acceptable on the day of application, as soon as the spray is dry. The MOE for this scenario is 195 at the application rate of 1.0 lbs ai/acre. MOEs are based on a dermal NOAEL of 5 mg/kg/day. The target MOE for all exposure scenarios is 100.

4.3.2.2 Cancer Post-Application Risk Characterization

The calculation of **cancer risk** for post-application exposure to workers mowing/maintaining golf course turf is 9.1×10^{-6} on the day of application, at the maximum application rate of 1.5 lbs. ai/acre. The calculation of cancer risk for workers scouting wheat and barley is 2.3×10^{-5} on the of application.

Restricted entry intervals have been estimated using the short- and intermediate-term endpoints. Additionally, the cancer endpoint was used to estimate REIs. HED's target range for cancer probabilities is 1×10^{-4} to 1×10^{-6} for occupational assessments. HED is generally concerned when occupational cancer risk estimates exceed 1×10^{-4} and will seek ways to mitigate cancer risks to a level of 1×10^{-6} or less. Historically, setting REIs on cancer endpoints has been difficult because of the need for lifetime use assumptions. To estimate the Lifetime Average Daily Dose, the typical application rate, the number of days worked per year, and the number of years one would be exposed during a working lifetime are needed. Each one of these variables are dependent upon many factors. For example, the number of days worked per year must correspond to the days worked when the pesticide of concern has been applied. Additionally, the residue dissipation over the work interval should be estimated. Without an estimate for residue dissipation one needs to assume that the worker travels from one treated field to another so that the highest residue value is always found. In the case of diclofop-methyl, a screening estimate was developed because lifetime use data are not available. The screening level estimate assumed:

(1) that scouts would be exposed for 10 days, golf course workers four days and golf course player two days a year; (2) no residue dissipation; and (3) a worker would be exposed for 35 years (50 years for golfers).

Given the high-end assumptions used in the post-application exposure assessment, HED does not believe that the cancer estimates are of concern.

4.3.2.3 Incident Data

The following databases have been consulted for poisoning incident data on diclofop-methyl: the OPP Incident Data System (IDS); Poison Control Center; California Department of Pesticide Regulation; and the National Pesticide Telecommunications Network (NPTN).

A total of 11 cases were reported from the IDS; however, none of the cases have documentation confirming exposure or health effects. Poison Control Center data reported two exposures to diclofop-methyl in adults, with one adult reporting minor effects and the other experiencing effects deemed unrelated to diclofop-methyl exposure. No data are available from the California data base, and diclofop-methyl was not reported to be involved in human incidents from the NPTN.

4.4 Non-Occupational Exposure

4.4.1 Non-Occupational Handler

There are no non-occupational handler exposure scenarios expected for diclofop-methyl. A non-occupational handler exposure assessment was not conducted.

4.4.2 Non-Occupational Post-Application Exposure

The Agency has determined that there are potential non-occupational, post-application exposure scenarios that may occur to golfers and children over six years old who accompany adults to a golf course that has been treated with diclofop-methyl. Since the ratio of body weight to surface area of adults is the same as for children, it can be assumed that non-occupational risks to adult golfers can be representative of children involved in similar activities. The SOP for Residential Exposure Assessments (completed in December, 1997) contains guidance for considering children's exposure to treated turf.

The following assumptions were used in estimating non-occupational post-application exposure to golfers: DFR values are assumed to be five percent of the application rate at day zero for turfgrass application; transfer coefficients are assumed to be 500 cm^2/hour; daily exposure is assumed to occur for four hours per day; average body weight is 70 kg; estimated exposure frequency to the highest residue level is 2 days/year; exposure duration is 50 years; and lifetime is assumed to be 70 years. The Q_1* used in the post-application assessment is 2.3×10^{-1} $(mg/kg/day)^{-1}$.

4.4.2.1 Non-Occupational Post-Application Risk Characterization

Non-cancer risk estimates indicate that entry by golfers is acceptable on the day of application as soon as the spray is dry. The MOE for this scenario is 210 at the highest application rate of 1.5 lbs. ai/acre.

Calculations of **cancer risk** for non-occupational, post-application exposure indicate that risk estimates on the day of application are 3.2×10^{-6} at the highest application rate, and 2.2×10^{-6} at the typical application rate . For non-occupational exposure, the Agency considers a cancer probability of less than 1×10^{-6} to be negligible.

The post-application risk assessment for golfers is based on surrogate data and assumptions related to the behavior and environmental fate of the chemical in the environment (e.g., dissipation of transferable residues). Due to a lack of pertinent data, factors used to calculate post-application risks (e.g., hours exposure per day) are based on the best professional judgement of Agency scientists.

5.0 AGGREGATE RISK ASSESSMENT

The Food Quality Protection Act amendments to the Federal Food, Drug, and Cosmetic Act (FFDCA, Section 408(b)(2)(A)(ii)) require that for establishing a pesticide tolerance "that there is reasonable certainty that no harm will result from aggregate exposure to pesticide chemical residue, including all anticipated dietary exposures and other exposures for which there are reliable information." Aggregate exposure will typically include exposures from food, drinking water, and residential uses of a pesticide. Aggregate risk assessments are conducted for acute (one day), short-term (one to seven days), intermediate-term (seven days to several months), and chronic (lifetime) exposure. Occupational exposure is not considered in any aggregate exposure assessment.

5.1 Acute Aggregate Risk

The acute aggregate risk estimate to diclofop-methyl addresses exposure from food and drinking water. Acute dietary food risks for females 13-50 are below the Agency's level of concern (<100% aPAD). The estimated concentration of diclofop-methyl in groundwater and surface water is below the Agency's level of concern for exposure to diclofop-methyl in drinking water as a contribution to acute aggregate risk.

Based on the available information, the Agency concludes with reasonable certainty that residues of diclofop-methyl in drinking water (when considered along with exposures from food uses) would not result in an acute aggregate human health risk estimate of concern.

5.2 Short-term Aggregate Risk

A short-term aggregate risk assessment considers exposure from food, water, and non-occupational (residential) sources of exposure to a pesticide. For diclofop-methyl, non-occupational, dermal short-term exposure (one to seven days) is likely to occur on golf courses, where it may be applied within a few hours of public usage.

The following equation (the reciprocal MOE approach) is used for calculating the short-term aggregate exposure to diclofop methyl, as the target MOEs are identical for all MOEs in the equation:

$$\text{Aggregate MOE} = \frac{1}{\frac{1}{MOE_{FOOD}} + \frac{1}{MOE_{WATER}} + \frac{1}{MOE_{DERMAL}}}$$

Calculated short-term DWLOCs do not exceed HED's level of concern as a contribution to short-term aggregate exposure. Based on available information, the Agency concludes with reasonable certainty that residues of diclofop-methyl in drinking water (when considered along with exposures from food uses and short-term non-occupational uses) would not result in a short-term aggregate human health risk estimate of concern.

5.3 Intermediate-term Aggregate Risk

An intermediate-term aggregate risk assessment was not conducted for diclofop-methyl. There are no non-occupational, intermediate-term (seven days to several months) exposure scenarios of concern as golfers are only expected to be exposed to the highest residue levels of diclofop-methyl two days per year.

5.4 Chronic (Non-Cancer) Aggregate Risk

The chronic (non-cancer) aggregate risk estimate to diclofop-methyl addresses exposure from food, drinking water, and residential sources of exposure. No chronic residential scenarios were identified for diclofop-methyl. Therefore, the chronic aggregate exposure assessment will address exposure from food and drinking water only.

Chronic dietary food risks are below the Agency's level of concern (<100% cPAD) for all population subgroups. The estimated concentration of diclofop-methyl in groundwater and surface water is below the Agency's level of concern for exposure to diclofop-methyl in drinking water as a contribution to chronic aggregate risk.

Based on the available information, the Agency concludes with reasonable certainty that residues of diclofop-methyl in drinking water (when considered along with exposures from food uses)

would not result in a chronic aggregate human health risk estimate of concern.

5.5 Cancer Aggregate Risk

The cancer aggregate risk estimate to diclofop-methyl addresses carcinogenic exposure from food, drinking water, and residential sources of exposure (in the case of diclofop-methyl, carcinogenic exposure to golfers). The Agency does not believe that exposure to residues of diclofop-methyl in food and drinking water will contribute to an unacceptable level of aggregate risk.

The carcinogenic exposure to golfers (3.2×10^{-6}) is a cancer risk of concern; therefore, any aggregation of carcinogenic exposure to golfers with carcinogenic exposure from food and drinking water will only increase the risk further above the Agency's level of concern. However, the Agency notes that the cancer risk estimate to golfers is based on high-end assumptions and may possibly overestimate risk.

6.0 DEFICIENCIES/DATA NEEDS

Additional data requirements for diclofop-methyl are identified as follows:

Product Chemistry Data Gaps:
830.1550 Product identity and composition
830.1670 Discussion of formation of impurities
830.1750 Certified limits
830.1800 Enforcement analytical method
830.7000 pH
830.7050 UV/Visible Absorption
830.7950 Vapor Pressure

Residue Chemistry Data Gaps:
860.1200 Directions for Use
860.1300 Plant Metabolism
860.1850 Confined Rotational Crops

7.0 ATTACHMENTS

Drinking Water Memorandum for Diclofop-Methyl. Subijoy Dutta; 10/14/99. D260166.
Product Chemistry Chapter for the Reregistration Eligibility Decision (RED) Document. Ken Dockter; 12/22/99. D259909.
Revised Report of the Hazard Identification Assessment Review Committee. Robert F. Fricke; 03/02/00.
Review of Diclofop-Methyl Incident Reports. Jerome Blondell and Monica F. Spann; 04/07/00. D264817.
Outcome of the HED Metabolism Assessment Review Committee Meeting on 4/4/00. Sheila Piper; 04/07/00.

D264794.
Report of the FQPA Safety Factor Committee. Brenda Tarplee; 04/24/00.
Residue Chemistry Chapter for the Reregistration Eligibility Decision (RED) Document. Sheila Piper; 05/02/00. D265277.
Toxicology Chapter for the RED. Robert F. Fricke; 05/04/00. D252787.
Report of the Cancer Assessment Review Committee. Sanjivani Diwan; 05/24/00.
Dietary Risk Assessment. Richard Griffin; 05/30/00. D265633.
Occupational and Residential Exposure Assessment and Recommendations. Seyed Tadayon; 08/02/00. D267650.

APPENDIX 1: Summary of Exposure Variables, MOEs, and Cancer Risks for Uses of Diclofop-Methyl

Exposure Scenario (Scenario #)	Application Rates (lb ai/A)	Acres Treated per Day	Total Short -term MOE			Total Intermediate-term MOE			Cancer		
			Baseline	PPE	Eng. Control	Baseline	PPE	Eng. Control	Baseline	PPE	Eng. Control
Mixer/Loader Risk											
Mixing/loading liquids for groundboom application (1)	1.0	80	2	165	NA	2	165	NA	1.60e-03/ 3.20e-03	9.61e-06/ 1.92e-05	4.90e-06/ 9.80e-06
	1.0	40	3	325	NA	3	325	NA	7.90e-04	4.80e-06	2.50e-06
	1.5		2	220	NA	2	220	NA	1.20e-03	7.21e-06	3.70e-06
Mixing/loading liquids for aerial application (2)	1.0	350	<1	60	110	<1	60	110	6.90e-03/ 1.40e-02	4.20e-05/ 8.40e-05	2.20e-05/ 4.40e-05
Mixing/loading liquids for hand gun sprayer (3)	1.0	5	25	2615	NA	25	2615	NA	9.80e-05	6.00e-07	NA
	1.5		15	1745	NA	15	1745	NA	1.50e-04	9.00e-07	NA
Applicator											
Applying liquids with a groundboom sprayer (4)	1.0	80	270	NA	NA	270	NA	NA	1.0e-05/ 2.0e-05	6.50e-06/ 1.30e-05	2.90e-06/ 5.80e-05
	1.0	40	535	NA	NA	535	NA	NA	5.10e-06	3.10e-06	1.40e-06
	1.5		360	NA	NA	380	NA	NA	7.70e-06	4.70e-06	2.10e-06
Applying liquids with a fixed-wing aircraft (5)	1.0	350	See Eng. .Control	See Eng. Control	165	See Eng. Control	See Eng. Control	165	See Eng. Control	See Eng. Control	1.30e-05/ 2.60e-05
Applying liquids with a hand gun sprayer (6)	1.0	5	See PPE	205	NA	See PPE	205	NA	See PPE	1.90e-05	NF
	1.5		See PPE	135	NA	See PPE	135	NA	See PPE	2.90e-05	NF
Flagger											
Flagging for liquid application (7)	1.0	350	85	NF	760	85	NF	760	9.50e-05/ 1.90e-04	NF	1.90e-06/ 3.80e-06

Baseline dermal exposure scenarios includes long pants, long shirts and no gloves. Baseline inhalation exposure represents no respirator
Additional dermal PPE for scenarios 1, 3 and 6 includes long pants, long shirts and gloves and for scenario 2 includes long pants, long shirts, gloves and coverall. additional inhalation PPE for senario 2 includes organic vapourt respirator (10-fold PF).
Engineering Controls dermal exposure value represents scenario 2 enclosed mixing and loading, scenario 5 Enclosed cockpits and scenario 7 enclosed cab with single layer clothes, no gloves
Target MOEs for all the above scenarios are 100.
Two exposure frequencies were used for wheat and barley in the calculations, the first represented the maximum number of applications per site per year to represent private use (10 days), and the second frequency applied a factor of 2 to the first frequency to represent commercial handlers making multiple applications per site per year (20 days) For golf courses 10 days per year.
Maximum PPE (coveralls and organic vapor respirator) were used for cancer assessment.

APPENDIX 2: Diclofop-Methyl Surrogate Postapplication Assessment for Treatment of Wheat, Barley, and Golf Course Turf.

Crop	Application-Rate	DAT[a]	DFR (g/-cm^2)[b]	Mow/Maintain Transfer coefficient =500 cm^2/hr				Golfing Transfer Coefficient =500				Scouting for wheat and barley Transfer coefficient = 100 cm^2/hr			
				Dermal Dose (mg/kg/-day)[c]	MOE[d]	LADD[e]	Cancer[f]	Dermal Dose (mg/kg/-day)[c]	MOE[d]	LADD[e]	Cancer[f]	Dermal Dose (mg/kg/-day)[c]	MOE[d]	LADD[e]	Cancer[f]
golf course turf	1.0	0	0.560	0.0048	155	2.63e-5	6.1e-6	0.0024	310	9.40e-6	2.2e-6	NA	NA	NA	NA
	1.5	0	0.841	0.0072	105	3.95e-5	9.1e-6	0.0036	210	1.41e-5	3.2e-6	NA	NA	NA	NA
wheat & barley	1.0	0	2.242	NA	NA	NA	NA	NA	NA	NA	NA	0.2562	195	1.0e-04	2.3e-05

[a] DAT is "days after treatment."

[B] DFR = Application rate x Conversion factor (lb ai/acre = 11.209 g/cm^2) x fraction of initial ai retained on foliage (20% for wheat and barley and 5 % for turf)* (1-daily dissipation rate), assuming a daily dissipation of 10%.

[C] Dermal Dose = [DFR(g/cm^2) x Transfer coefficient (cm^2/hr) x conversion factor (1 mg/1,000 g) x Exposure duration (8 hours/day except for golfers (4 hours/day)) / body weight (70 kg)]

[d] MOE = NOAEL (mg/kg/day) / Dermal Dose (mg/kg/day); where NOAEL = 5 mg/kg/day. An MOE of $\geq$ 100 is acceptable.

[E] LADD (mg/kg/day) = Dermal Daily Dose (mg/kg/day) * (Number of days exposure per year) /365 days per year) * years worked/70 year lifetime.
(Number of days exposed for golf course maintenance 4 days per year, number of years exposed for golfing 2 days a year and number of days estimated for scouting 10days per year)
Number of years exposed for golf course maintenance and scouting, 35 years and 50 years for golfers

[f] Cancer Risk = LADD (mg/kg/day) * (Q_1*), where Q_1* = 2.30e^{-1} (mg/kg/day).